

## SDEC 2017 Questions, Group 1

1. Do the factory wings that many fluorescent troffers have designed to fold out over the grid meet the requirements for “securely fastened to the framing”?

**Answer:** NEC 410.36(B) Yes, if marked for use with the grid. 410.36(B) Requires as bolts, screws, or rivets or Listed clips identified for use with the type of ceiling framing member and luminaire.

### **410.36 Means of Support.**

**(B) Suspended Ceilings.** Luminaires shall be securely fastened to the ceiling framing member by mechanical means such as bolts, screws, or rivets. Listed clips identified for use with the type of ceiling framing member(s) and luminaire(s) shall also be permitted.

2. Is it allowed to use the grounding grid of a swimming pool’s patio to be used as the grounding electrode system for a separate structure’s pool equipment room?

**Answer:** No. 250.52(B) prohibits the equipotential ground plane of a swimming pool to be used as a grounding electrode. The rebar around the swimming pool is for bonding only.

**(B) Not Permitted for Use as Grounding Electrodes.** The following systems and materials shall not be used as grounding electrodes:

- (1) Metal underground gas piping systems
- (2) Aluminum
- (3) The structures and structural reinforcing steel described in 680.26(B)(1) and (B)(2)

3. 2011 NEC 250.32 Buildings or Structures Supplied by a Feeder(s) or Branch Circuit(s) requires that an EGC be installed with the feeder conductors and bonded to the subpanel in the outbuilding. In addition, a GEC is to be installed to all available electrodes at the separate structure. If there are no available electrodes and a ground rod is driven and an appropriately sized GEC installed, is it required that this ground rod be supplemented as required in Article 250.53(A)(2), or can the one ground be considered supplemented by the main electrode system using the EGC to bond them together?

**Answer:** It appears to me that this question is asking if the grounding electrode for the main building can be used as the supplemental electrode for the detached building by using the equipment grounding conductor required by 250.32(B)(1) as a grounding electrode conductor too.

In that case, the answer is no as 250.121 states that an equipment grounding conductor shall not be used as a grounding electrode conductor. The grounding electrode for the main building could be used as a supplemental electrode for the detached building, but there would need to be an equipment grounding conductor installed to comply with 250.32(B)(1). This would allow any of the equipment grounding conductors permitted by 250.118 and sized per 250.122 where applicable. Then there would also need to be a grounding electrode conductor installed to comply with 250.64 and sized in accordance with 250.66.

It would be better and easier to install a second ground rod at the second building.

4. A basement is finished except for the concrete floor which remains original. Is GFCI protection required for all 120volt outlets in this area?

**Answer:** NO. 210.8 (A) (5) If areas in the basement are finished (finished walls and ceilings) and intended for habitable use, then the receptacles in those areas are not required to be GFCI protected, they are required to be AFCI protected, just the receptacles in the unfinished areas (not intended for habitable use) require to be GFCI protected. Floor covering is not required to make a habitable room.

5. In a small aircraft hangar where the aircraft has its fuel tanks in the wings, is it allowed to have electrical outlets on the side walls by the wings for servicing the aircraft?

**Answer:** No, Yes, Maybe. Depending on the size of the airplane, size of the hangar, and where the airplane will be normally parked. The classifications around the airplane is as follows, 513.3(C)(1) and 513.4(A)

## **ARTICLE 513 Aircraft Hangars**

### **513.3 Classification of Locations.**

#### **(C) Vicinity of Aircraft.**

**(1) Aircraft Maintenance and Storage Hangars.** The area within 1.5 m (5 ft) horizontally from aircraft power plants or aircraft fuel tanks shall be classified as a Class I, Division 2 or Zone 2 location that shall extend upward from the floor to a level 1.5 m (5 ft) above the upper surface of wings and of engine enclosures.

#### **513.4 Wiring and Equipment in Class I Locations.**

**(A) General.** All wiring and equipment that is or may be installed or operated within any of the Class I locations defined in 513.3 shall comply with the applicable provisions of Article 501 or Article 505 for the division or zone in which they are used.

Attachment plugs and receptacles in Class I locations shall be identified for Class I locations or shall be designed such that they cannot be energized while the connections are being made or broken.

6. Can PVC conduit be installed under the floor of a Commercial Garage (NEC 511) and if so are there any restrictions?

**Answer:** No... 511.8. This is new in the 2017 NEC, the only raceways that are permitted to be used under the floor in a commercial garage is rigid steel conduit, or IMC. There is an exception that does allow PVC under the floor.

**511.8 Underground Wiring.** Underground wiring shall be installed in threaded rigid metal conduit or intermediate metal conduit.

*Exception: Type PVC conduit, Type RTRC conduit, and Type HDPE conduit shall be permitted where buried under not less than 600 mm (2 ft) of cover. Where Type PVC conduit, Type RTRC conduit, or Type HDPE conduit is used, threaded rigid metal conduit or threaded steel intermediate metal conduit shall be used for the last 600 mm (2 ft) of the underground run to emergence or to the point of connection to the aboveground raceway, and an equipment grounding conductor shall be included to provide electrical continuity of the raceway system and for grounding of non-current-carrying metal parts.*

7. In a single family dwelling, can I bond the water line to a sub panel ground bar and not at the main panel if the incoming waterline is plastic and the house waterline is copper? If so, what size wire do I need to bond it with if I've fed the house with 4/0 aluminum?

**Answer:** No... 250.104(A). The water pipes must be bonded to the service equipment or the grounding electrodes. The bonding conductor is sized as per 250.102, which would be #4 copper.

### **250.104 Bonding of Piping Systems and Exposed Structural Metal.**

**(A) Metal Water Piping.** The metal water piping system shall be bonded as required in (A)(1), (A)(2), or (A)(3) of this section.

**(1) General.** Metal water piping system(s) installed in or attached to a building or structure shall be bonded to any of the following:

- (1) Service equipment enclosure
- (2) Grounded conductor at the service
- (3) Grounding electrode conductor if of sufficient size
- (4) One or more grounding electrodes used, if the grounding electrode conductor or bonding jumper to the grounding electrode is of sufficient size

**8.** An RTU is placed on a metal frame for weight dissipation & built up to where the controller and the breaker (disconnect) is now 8' AFF. Is it required to install a working platform 30" x 36" or is a ladder to access and service the unit NEC- compliant?

**Answer:** Using a portable ladder to access the breaker is ok, NEC 240.24(4) and 404.8 exception 2.

240.24 For overcurrent devices adjacent to utilization equipment that they supply, access shall be permitted to be by portable means.

404.8 exception 2... *Exception No. 2: Switches and circuit breakers installed adjacent to motors, appliances, or other equipment that they supply shall be permitted to be located higher than 2.0 m (6 ft 7 in.) and to be accessible by portable means.*

**9.** What is the minimum size junction box that can be installed to enclose a power distribution block that measures 6" x 6" and has two parallel 3/0 AWG copper conductors per phase terminated on both sides of the block?

**Answer:** You have to determine the size of the junction box using 314.28 the size of conduit entries and number of conduits entering the box. Then you must follow all the requirements in 314.28(E). The box cannot be smaller than the installation instructions that come with the power distribution blocks. You must also calculate wire bending space in table 312.6(A). Code references to use to answer this question are 314.28, 314.28(E) and table 312.6(A).

**10.** Can you run NM cable from a panel in a residence through wood walls & ceiling and then run it in ½" EMT surface- mounted? This is run to several devices in a concrete basement. Can it be done without stripping the outer jacket off the NM cable, or does it need to be removed?

**Answer:** NEC 334.10 Uses Permitted

NEC 334.15(C) In Unfinished Basements and Crawl Spaces

NM Cable can be run through wood walls and ceilings including the wood joist of an exposed basement ceiling per 334.10 and 334.15(C).

NM Cable is required to be installed in a Listed conduit or tubing, such as EMT, when installed on a wall of an unfinished basement. A bushing or adapter needs to be installed at the entry of the raceway. The sheathing is required to be in place through the raceway and into the outlet box.

**11.** For Power distribution units (PDU's) inside a room designated "information technology" with field installation using MC to 4-plex receptacle boxes under the floor, is it required to secure & support the boxes and wiring methods as stated in 645.5(E)(1)?

**Answer: Article 645.5 (E) (1) would apply in this installation.**

Branch-circuit conductors installed under the raised floor of an ITE room using any of the wiring methods listed in 645.5(E)(1) are required to conform to the specific article for the wiring method used. In addition, Article 300 applies, except where modified by Article 645. For example, 300.11 requires raceways, cables, and boxes to be securely fastened in place, even though they are installed below a raised floor. 645.5 (F) Applies to equipment that is listed as information technology equipment which wouldn't have to comply to 645.5 (E) (1).

**12.** There is a residence that has a library 16' x 20' with built in book cases floor to ceiling along all 4 of the walls. Do I have to install floor boxes to meet wall space receptacle requirement of 210.52?

**Answer:** No, 210.52(A)(2). There is new wording in the 2017 NEC that addresses walls spaces with fixed cabinets. However it may not be a bad idea to install some receptacles in the book cases

**(1) Spacing.** Receptacles shall be installed such that no point measured horizontally along the floor line of any wall space is more than 1.8 m (6 ft) from a receptacle outlet.

**(2) Wall Space.** As used in this section, a wall space shall include the following:

(1) Any space 600 mm (2 ft) or more in width (including space measured around corners) and unbroken along the floor line by doorways and similar openings, fireplaces, and fixed cabinets that do not have countertops or similar work surfaces.

**13.** I have two islands in my house, one is for the kitchen and one is for my wet bar in another room. They both have a receptacle within 6' of the sink installed on the back side of the island. The inspector is requiring that both receptacles be GFCI protected, is he correct?

**Answer:** Yes, he is correct. NEC 210.8(A)(7)

**210.8 Ground-Fault Circuit-Interrupter Protection for Personnel.**

Ground-fault circuit-interrupter protection for personnel shall be provided as required in 210.8(A) through (E). The ground-fault circuit interrupter shall be installed in a readily accessible location.

(7) Sinks — where receptacles are installed within 1.8 m (6 ft) from the top inside edge of the bowl of the sink  
Before the 2014 NEC, receptacles within 6 feet of a kitchen sink was excluded from the GFCI requirement.

**14.** Does the NEC require sizing raceways and their support racks to allow for future expansion?

**Answer:** No, not really, NEC 90.8, Wire Planning.

The NEC does not mandate it, however, per 90.8 it does make the recommendation to plan for future expansion by providing ample space in raceways, having spare raceways, and allowing for additional spaces for increases in future electrical and/or communication expansions.

**15.** Conduits and their end fittings are installed at the bottom of an open-bottom switchboard. How far into the switchboard can these raceways extend?

**Answer:** 408.5, The maximum length of conduit that can enter the open bottom switchboard is 3 inches.

**408.5 Clearance for Conductor Entering Bus Enclosures.**

Where conduits or other raceways enter a switchboard, switchgear, floor-standing panelboard, or similar enclosure at the bottom, approved space shall be provided to permit installation of conductors in the enclosure. The wiring space shall not be less than shown in Table 408.5 where the conduit or raceways enter or leave the enclosure below the busbars, their supports, or other obstructions. The conduit or raceways, including their end fittings, shall not rise more than 75 mm (3 in.) above the bottom of the enclosure.

**16.** Where ground-fault protection of a service disconnecting means is provided and the available fault current exceeds 10,000 amperes, what is the maximum time-delay setting for the ground-fault equipment?

**Answer:** NEC 230.95 Ground-Fault Protection of Equipment. Maximum time-delay setting is **one** second  
**(A) Setting. The ground-fault protection system shall operate** to cause the service disconnect to open all ungrounded conductors of the faulted circuit. The maximum setting of the ground-fault protection shall

be 1200 amperes, and the maximum time delay shall be one second for ground-fault currents equal to or greater than 3000 amperes.

**17.** Can a ground rod be used on a light pole or other equipment rather than installing an equipment grounding conductor with the circuit conductors?

**Answer:** NO!! 250.4(A)(5) and 250.110

Take a look at the Effective Ground-Fault Current Path requirements of 250.4(A)(5). Electrical equipment and wiring and other electrically conductive material likely to become energized shall be installed in a manner that creates a low-impedance circuit facilitating the operation of the overcurrent device or ground detector for high-impedance grounded systems. It shall be capable of safely carrying the maximum ground-fault current likely to be imposed on it from any point on the wiring system where a ground fault may occur to the electrical supply source. **The earth shall not be considered as an effective ground-fault current path.**

**250.110 Equipment Fastened in Place (Fixed) or Connected by**

**Permanent Wiring Methods.** Exposed, normally non-current carrying metal parts of fixed equipment supplied by or enclosing conductors or components that are likely to become energized shall be connected to an equipment grounding Conductor.

**18.** Can you explain the grounding requirements for a service that consists of up to six switches or six circuit breakers in a group of separate enclosures?

**Answer:** 250.64(D)

**250.64 Grounding Electrode Conductor Installation.**

**(D) Building or Structure with Multiple Disconnecting Means in Separate Enclosures.** If a building or structure is supplied by a service or feeder with two or more disconnecting means in separate enclosures, the grounding electrode connections shall be made in accordance with 250.64(D)(1), 250.64(D)(2), or 250.64(D)(3).

**(1) Common Grounding Electrode Conductor and Taps.**

**(2) Individual Grounding Electrode Conductors.**

**(3) Common Location.**

**19.** What is the NEC definition of a "Permanent Barrier" as used in 314.28(D). Does this mean it has to be welded, screwed, etc...?

**Answer:** Some types of boxes (both metal and nonmetallic boxes) are capable of accepting fixed barriers that are accessory features provided by the box manufacturer. Check with the box manufacturer for the type of box that can be equipped with a barrier to meet the requirements of this section. The proper type box must be installed during the rough-in. If you try to weld or build a barrier into a box that is not listed for barriers, that will probably not be acceptable by the AHJ, Use only listed boxes and barriers for that brand of box.

**20.** In a residence I have an electrical panel located in a mechanical room 12'w x 8'd x 8'h meeting all the requirements of 110.26 for space and clearances, but it is only accessed through the crawl space which is only 3 feet in height and 10 feet long. Is this an acceptable location for the electrical panel for the house?

**Answer:** 230.70(A)(1) requires the service disconnect is to be in a readily accessible location. 240.24 requires the overcurrent devices in the panel to be readily accessible. The definition of readily accessible was changed in the 2017 NEC to include crawling under. The answer would be no, based on the definition of readily accessible.

**Accessible, Readily (Readily Accessible).** Capable of being reached quickly for operation, renewal, or inspections without requiring those to whom ready access is requisite to take actions such as to use tools (other than keys), to climb over **or under**, to remove obstacles, or to resort to portable ladders, and so forth.

**21.** Can we install Nonmetallic Sheathed Cable in a wet location above ground if we place it inside a raceway?

**Answer:** NEC 334.12(B)(4) Uses Not Permitted, NEC 300.9 Raceways in Wet Locations Above grade. No, 300.9 makes it clear that the interior of a raceway is consider a wet location when the raceway is installed in a wet location above grade. 334.12(B)(4) tells us that NM Cable cannot be used in a wet location.

**22.** Can a neutral conductor be used for bonding a meter enclosure with a panelboard mounted right beside the meter? I have installed PVC conduit between the enclosures. The inspector has requested I install a bonding jumper in addition to the neutral in the PVC. Which is correct?

**Answer:** The inspector could be right, or he could be wrong. It depends on the meter enclosure. If the neutral lug is bonded to the meter enclosure, then an additional bonding jumper would not be required. However some meter enclosures have the ability to isolate the neutral lug from the enclosure. If the neutral lug is isolated from the enclosure in this installation, then an additional bonding jumper from the service panel to the meter enclosure would be required. 250.92 (A) and (B).

**23.** The interior of a panelboard got a little overspray from the drywall installation. How do we determine what to do with the panel interior?

**Answer:** Remove the panelboard and either replace it with a new one, or send it back to the manufacture to be cleaned. Do not try to clean the panel board. Any abrasives or chemicals you use could damage the integrity of the buss bars.

**110.12 (B) Integrity of Electrical Equipment and Connections.** Internal parts of electrical equipment, including busbars, wiring terminals, insulators, and other surfaces, shall not be damaged or contaminated by foreign materials such as paint, plaster, cleaners, abrasives, or corrosive residues. There shall be no damaged parts that may adversely affect safe operation or mechanical strength of the equipment such as parts that are broken; bent; cut; or deteriorated by corrosion, chemical action, or overheating.

**24.** If a metal cover is installed on a concrete hand hole installed in the ground, is the cover required to be grounded? I could not find a reference, but heard it was required.

**Answer: 314.30(D) Covers.** Hand hole enclosure covers shall have an identifying mark or logo that prominently identifies the function of the enclosure, such as “electric.” Hand hole enclosure covers shall require the use of tools to open, or they shall weigh over 45 kg (100 lb). **Metal covers and other exposed conductive surfaces shall be bonded** in accordance with 250.92 if the conductors in the hand hole are service conductors, or in accordance with 250.96(A) if the conductors in the hand hole are feeder or branch circuit conductors.

**25.** I am wiring an office building, there is a small meeting room that is 30 feet by 30 feet. The electrical engineer drew only 2 receptacles in that room. Should there be more receptacles in that meeting room.

**Answer:** Yes, there should be more receptacles. There is a new code section in the 2017 NEC that addresses meeting rooms.

### **210.71 Meeting Rooms.**

**(A) General.** Each meeting room of not more than 93 m<sup>2</sup> (1000 ft<sup>2</sup>) in other than dwelling units shall have outlets for Non locking-type, 125-volt, 15- or 20-ampere receptacles. The outlets shall be installed in accordance with 210.71(B). Where a room or space is provided with movable partition(s), each room size shall be determined with the partition in the position that results in the smallest size meeting room.

**(B) Receptacle Outlets Required.** The total number of receptacle outlets, including floor outlets and receptacle outlets in fixed furniture, shall not be less than as determined in (1) and (2). These receptacle outlets shall be permitted to be located as determined by the designer or building owner.

**(1) Receptacle Outlets in Fixed Walls.** Receptacle outlets shall be installed in accordance with 210.52(A)(1) through (A)(4)

**(2) Floor Receptacle Outlets.** A meeting room that is at least 3.7 m (12 ft) wide and that has a floor area of at least 20 m<sup>2</sup> (215 ft<sup>2</sup>) shall have at least one receptacle outlet located in the floor at a distance not less than 1.8 m (6 ft) from any fixed wall for each 20 m<sup>2</sup> (215 ft<sup>2</sup>) or major portion of floor space.

**26.** Should the lightning protection system ground terminals be bonded to the electrical grounding electrode system of a building?

**Answer:** Yes, Article 250.106 Lightning Protection Systems. The lightning protection system ground terminals shall be bonded to the building or structure grounding electrode system.

Informational Note No. 1: See 250.60 for use of strike termination devices. For further information, see NFPA 780-2014, *Standard for the Installation of Lightning Protection Systems*, which contains detailed information on grounding, bonding, and sideflash distance from lightning protection systems.

Informational Note No. 2: Metal raceways, enclosures, frames, and other non-current-carrying metal parts of electrical equipment installed on a building equipped with a lightning protection system may require bonding or spacing from the lightning protection conductors in accordance with NFPA 780-2014, *Standard for the Installation of Lightning Protection Systems*.

**27.** I installed a short rigid nipple out the back of a panel to an LB that has a 5' length of EMT to a disconnect switch for an AC unit. It only has #10 copper wires in the conduit and the inspector wants a bushing on the inside of the panel. Is he correct?

**Answer:** The inspector is correct. A bushing is required on rigid conduit regardless on the size of conductors, NEC 344.46

**344.46 Bushings.** Where a conduit enters a box, fitting, or other enclosure, a bushing shall be provided to protect the wires from abrasion unless the box, fitting, or enclosure is designed to provide such protection.

**28.** I am installing a 600 amp service and just started to terminate the service conductors. The inspector walked in on me and asked to see my torque wrench. Why would he ask such a crazy question?

**Answer:** There is a new code section in the 2017 NEC that requires the use of torquing tools, 110.14(D). He asked that question to make sure you are following code requirements.

**(D) Installation.** Where a tightening torque is indicated as a numeric value on equipment or in installation instructions provided by the manufacturer, a calibrated torque tool shall be used to achieve the indicated torque value, unless the equipment manufacturer has provided installation instructions for an alternative method of achieving the required torque.

**29.** Does a building ground ring need to be sized per 250.66 or is the minimum size of #2cu per 250.52 sufficient for any size service?

**Answer:** No, NEC section 250.52 (A)(4) only requires the ground ring to be a minimum of a #2 AWG, there is not a requirement for it to be any larger. Section 250.66 is for sizing the grounding electrode conductor, not the grounding electrode. Even section 250.66(C) states that where the grounding electrode conductor does not extend on to other types of electrodes that require a larger size of conductor, the grounding electrode conductor shall not be required to be larger than the conductor used for the ground ring.

Now, if the ground ring is part of a daisy-chained grounding electrode system where NEC section 250.64(F) would be applicable. The ground ring actually becomes a bonding jumper interconnecting the grounding electrodes and would be required to be sized in accordance with 250.66 as required by 250.53(C).

**30.** I will be wiring a church in the near future, in the kitchen there will be 3 50 amp range receptacles installed. I heard rumors that those receptacles would be required to be GFCI protected. Is that true?

**Answer:** Yes, that is true. There is a change in the 2017 NEC 210.8(B), requiring all receptacles in the list of locations be GFCI protected. Kitchens are on that list.

**210.8(B) Other Than Dwelling Units.** All single-phase receptacles rated 150 volts to ground or less, 50 amperes or less and three phase receptacles rated 150 volts to ground or less, 100 amperes or less installed in the following locations shall have ground-fault circuit-interrupter protection for personnel.

- (1) Bathrooms
- (2) Kitchens
- (3) Rooftops

**31.** Are there differences on how a 15 and 20 amp receptacle is constructed?

**Answer:** UL White Book information:

- **RECEPTACLES FOR PLUGS AND ATTACHMENT PLUGS (RTRT)**

• Differences:

- 15 amp have the ability of stab-lock of 14 gauge wire, do not try to install 12 gauge wire into a stab lock that is made for 14 gauge. It will damage the stab lock.
- 20amp have screws to mechanically secure the wire to the device
- The faces will have a different NEMA configurations are different between the 15amp and 20amp.

**32.** When determining the Maximum Rating or Setting of Motor Branch-Circuit Short-Circuit and Ground-Fault Protective Device using Table 430.52, do I use the motor amperages shown in Tables 430.247 through 430-250 for all type of motor applications or the nameplate rating on the motor(s)?

**Answer:** 430.6(A)(1), 430.52(C). The sizing of the short circuit and ground fault protective device is based on the NEC table values and not the nameplate value on the motor. The tables are utilized in lieu of the nameplate to allow for future replacement motors which may be of a higher value. Examples:

7.5 hp @ 480 volt, 3 phase Table 430.150 – 11 amps. Motor nameplate – 9.3 amps

7.5 hp @ 230 volt, 3 phase Table 430.150 – 22 amps. Motor nameplate – 18.6

**33.** According to the 2017 NEC, what are the branch circuit requirements in an attached garage to a dwelling?

**Answer:** 210.11(C)(4), A minimum of 2 branch circuits in a garage. One 20 amp circuit for the receptacles and this circuit shall have no other outlets. Another branch circuit for the lights, either 15 amp, or 20 amp. All receptacles in a garage are required to be on 20 amp branch circuits, including receptacles for garage door openers.

**(4) Garage Branch Circuits.** In addition to the number of branch circuits required by other parts of this section, at least one 120-volt, 20-ampere branch circuit shall be installed to supply receptacle outlets in attached garages and in detached garages with electric power. This circuit shall have no other outlets.

*Exception: This circuit shall be permitted to supply readily accessible outdoor receptacle outlets.*

**34.** Can the concrete pillars used to support a manufactured home be used for the UFER grounding electrode?

**Answer:** Depends on how the pillar is constructed. And if it meets the requirements of 250.52(A)(3).

**(3) Concrete-Encased Electrode.** A concrete-encased electrode shall consist of at least 6.0 m (20 ft) of either (1) or (2):

(1) One or more bare or zinc galvanized or other electrically conductive coated steel reinforcing bars or rods of not less than 13 mm (1/2 in.) in diameter, installed in one continuous 6.0 m (20 ft) length, or if in multiple pieces connected together by the usual steel tie wires, exothermic welding, welding, or other effective means to create a 6.0 m (20 ft) or greater length; or

(2) Bare copper conductor not smaller than 4 AWG

Metallic components shall be encased by at least 50 mm (2 in.) of concrete and shall be located horizontally within that portion of a concrete foundation or footing that is in direct contact with the earth or within vertical foundations or structural components or members that are in direct contact with the earth. If multiple concrete-encased electrodes are present at a building or structure, it shall be permissible to bond only one into the grounding electrode system.

You cannot jump from one pillar to another pillar to get the 20 feet of rebar. The 20 feet of rebar must be one continuous length.

**35.** I am installing a 20 amp duplex receptacle fed with a 20 amp multi-wire branch circuit. Each half of the duplex receptacle will have a 16 amp load for a total on the duplex of 32 amps. Is each half of the duplex receptacle rated 20 amps, or is the rating for the entire duplex receptacle?

**Answer:** 210.21(B) and Table 210.21(B)(2). The 20 amp rating is for each half of the duplex receptacle.

A duplex receptacle is actually 2 receptacles on one yoke. The ratings in the table is for one receptacle. Table 210.21(B)(2) allows up to 16 amps load on a 20 amp receptacle. This installation is code compliance.

**36.** I am installing a 100 amp service outside for street lighting. Do I have to install a 120 volt, 15 or 20 amp receptacle by the service panel?

**Answer:** Yes, in the 2014 NEC, and No in the 2017 NEC. The 2014 NEC requires a receptacle within 50 feet of any service, indoors or outdoors. The 2017 NEC requirement is for indoor installations only.

**210.64 Electrical Service Areas.** At least one 125-volt, single phase, 15- or 20-ampere-rated receptacle outlet shall be installed in an accessible location within 7.5 m (25 ft) of the indoor electrical service equipment. The required receptacle outlet shall be located within the same room or area as the service equipment.

*Exception No. 1: The receptacle outlet shall not be required to be installed in one- and two-family dwellings.*

**37.** Is it permissible to utilize the 83% sizing in 310.15(B)(7) and install two parallel runs of 4/0 aluminum SER cable for a 400 ampere main power feeder for a single family dwelling?

**Answer:** NEC 310.15(B)(7) – **Single-Phase Dwelling Services and Feeders.**

If the parallel feeders terminate in a single 400 amp service, then yes, the 83% sizing can be used. If the feeders terminate in 2 200 amp panels, then No, you cannot use the 83%. This code section is for a single service or panel that carries the entire load of the dwelling. The table that used to be in previous codes is now located in example D7 in Annex D.

**38.** I have a duplex dwelling that has the electric hot- water heaters for both units located in the basement of one of the units. They are being fed from circuit breakers in the electrical panels in each unit with breaker locks for the water heaters. If a problem arises with the water heater where the person does not have access to correct the issue, is this a code violation of Art. 210.25?

**Answer:** NEC 210.25(A) and NEC 240.24(A) and (B)

Yes, several violations. 210.25(A) requires that branch circuits in one dwelling unit supply only loads within that dwelling unit. 240.24(A) requires that overcurrent devices shall be readily accessible and they would not be readily accessible in this case. 240.24(B)

Requires that each occupant have ready access to overcurrent devices protecting conductors within that occupancy.

**39.** I am installing a 277/480 volt, 1200 amp service in an office building. The main breaker has Ground fault protection. What are the 2017 requirements for testing the GFPE?

**Answer:** 230.95(C). The testing must be done by a qualified person using a test process of primary current injection. This is usually done by the manufacture or an electrical engineer with the proper equipment. Just by pushing the test button on the breaker is not acceptable.

**(C) Performance Testing.** The ground-fault protection system shall be performance tested when first installed on site. This testing shall be conducted by a qualified person(s) using a test process of primary current injection, in accordance with instructions that shall be provided with the equipment. **A written record of this testing shall be made and shall be available to the authority having jurisdiction.**

**40.** Is it a violation to install a GFCI receptacle for the vending machine behind the vending machine indoors in a hallway of a commercial building?

**Answer:** Yes. The GFCI must be readily accessible. According to the definition of readily accessible, you must be able to get to the GFCI receptacle quickly without removing obstacles.

Vending machines whether indoors or outdoors require GFCI protection. NEC 422.5(A) and (B).

422.5(A) list the appliances that require GFCI protection, and 422.5(B) tells you what kind of GFCI devices you may use.

**422.5 Ground-Fault Circuit-Interrupter (GFCI) Protection for Personnel.**

**(A) General.** Appliances identified in 422.5(A)(1) through (5) rated 250 volts or less and 60 amperes or less, single- or 3-phase, shall be provided with GFCI protection for personnel. Multiple GFCI protective devices shall be permitted but shall not be required.

(1) Automotive vacuum machines provided for public use

(2) Drinking water coolers

(3) High-pressure spray washing machines — cord-and-plugconnected

(4) Tire inflation machines provided for public use

## (5) Vending machines

**(B) Type.** The GFCI shall be readily accessible, listed, and located in one or more of the following locations:

- (1) Within the branch circuit overcurrent device
- (2) A device or outlet within the supply circuit
- (3) An integral part of the attachment plug
- (4) Within the supply cord not more than 300 mm (12 in.) from the attachment plug
- (5) Factory installed within the appliance

The GFCI device for vending machines could be a receptacle, breaker, or in the vending machine cord.

**41.** When sealing the inside of electrical conduits, can I use any kind of sealants, such as spray insulating foam in a can?

**Answer:** The 2014 NEC does not give a direct answer to this question. In 300.7 says that the sealant must be an approved sealant. This could mean approved to be used around conductors or by the AHJ. In the 2017 NEC, 300.5(G) and 230.8 says the sealant must be identified for use around conductors. To answer this question, insulating spray foam would not be approved for sealing inside conduits.

**42.** I have mounted transformers in a cabinet under the kitchen sink to feed low- voltage lighting in a dwelling kitchen. Is the 120- volt circuit to the transformer required to be arc- fault protected?

**Answer:** Yes. 210.12 and article 100 definitions. A transformer is a device.

**Device.** A unit of an electrical system, other than a conductor, that carries or controls electric energy as its principal function.

210.12 includes devices and outlets that would require AFCI

**210.12 Arc-Fault Circuit-Interrupter Protection.** Arc-fault circuit-interrupter protection shall be provided as required in 210.12(A), (B), and (C). The arc-fault circuit interrupter shall be installed in a readily accessible location.

**(A) Dwelling Units.** All 120-volt, single-phase, 15- and 20- ampere branch circuits supplying outlets or devices installed in dwelling unit kitchens, family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, laundry areas, or similar rooms or areas shall be protected by any of the means described in 210.12(A)(1) through (6).

Also if you provide a receptacle for the transformer, the receptacle would require to be GFCI protected also.

**43.** We are installing 26 – campground RV pedestals that have a 50 amp / 30 amp / 20 amp outlet in them. We are installing a 200 amp feed and connecting 6 pedestals to each 200 amp feeder. We are installing 4 wires to each pedestal. Do we still need to install 2 ground rods per pedestal. We are having a lengthy debate here at the shop and would like to know your thoughts on this installation.

**Answer:** I can understand why the debate over this question. In the 2014 and older codes, a person could interpret the code and require ground rods at each RV pedestal. 210.32 requires grounding electrodes at each building or structure. The NEC definition of a structure is that which is built or constructed, an RV pedestal could be considered as built, inspectors in SD consider RV pedestals as equipment, thus not requiring ground rods. In the 2017 NEC there is a change in the definition of structure.

**Structure.** That which is built or constructed, **other than equipment.** (CMP-1)

2017 NEC 551.75(B) states that RV pedestals are not required to have ground rods.

**(B) Grounding Electrode.** Power outlets or recreational vehicle site supply equipment, other than those used as service equipment, shall not be required to have a grounding electrode. An auxiliary grounding electrode(s) in accordance with 250.54 shall be permitted to be installed.

To answer this question, ground rods are not required to be installed at RV pedestals.

**44.** I am wiring the front counter of a restaurant that has sensitive electronics that require an isolated ground circuit. Can I install 12/3 MC cable and tape the red wire green, or strip the red wires and use it for my isolated ground? Can I use Medical MC cable or Medical AC cable?

**Answer:** 250.146(D) explains the required installation of isolated grounded receptacles. The isolated grounding conductor is required to be insulated and can be run through boxes and panelboards without terminating to any boxes or subpanels.

250.119(B) Yes, you are permitted to mark the red wire green and use it for the isolated ground. If the red insulation is removed, use it for the regular, not isolated, ground. The isolated ground wire is required to be insulated.

**250.119 Identification of Equipment Grounding Conductors.**

**(B) Multiconductor Cable.** Where the conditions of maintenance and supervision ensure that only qualified persons service the installation, one or more insulated conductors in a multiconductor cable, at the time of installation, shall be permitted to be permanently identified as equipment grounding conductors at each end and at every point where the conductors are accessible by one of the following means:

(1) Stripping the insulation from the entire exposed length.

(2) Coloring the exposed insulation green.

(3) Marking the exposed insulation with green tape or green adhesive labels. Identification shall encircle the conductor

To answer the second question, yes, hospital grade MC and AC cables could also be used, the outside metal jacket is a listed equipment grounding conductor, and the insulated green wire can be used for the isolated equipment ground.

**45.** A long-standing requirement in the National Electrical Code (NEC) is to provide a service disconnecting means for each building or structure served by electricity. The concept is simple; the disconnecting means serves as a ready means for the occupant or other responder to remove all power from the building by operating the service disconnect. What is meant by the term “grouped” as it is used in Section 230.72 of the NEC?

**Answer:** AHJ Determination

230.72 Grouping of Disconnects.

**(A) General.** The two to six disconnects as permitted in 230.71 shall be grouped. Each disconnect shall be marked to indicate the load served.

The NEC does not state how close the two to six disconnects must be in order to be considered grouped in any one location. The judgment is left up to the AHJ for good a reason. For example two mains on either side an aisle may be considered grouped, but that depends on how clearly they are identified and how readily they could be operated. The AHJ should make this decision based on the intent of the NEC, that is, based on safety considerations. It is simply a reasonable requirement and limitation for readily and quickly disconnecting power, when necessary.

**46.** When direct burial conductors emerge from the ground, they are to be protected from damage by using schedule 80 PVC, rigid conduit, or IMC. I understand there is a code change in the 2017 NEC that also allows EMT conduit. So my question is, am I allowed to use EMT conduit in direct contact with the earth?

**Answer:** 300.5(D)(4) and 358.10 does allow EMT in direct contact with the earth, and in concrete that is in direct contact with the earth. However in SD we do not allow EMT to be in direct contact with the earth, or in concrete that is in direct contact with the earth

**20:44:22:12. Electrical metallic tubing.** Electrical metallic tubing may not be used in concrete below grade or in concrete slab or masonry in direct contact with earth nor embedded in earth or fill. The use of a vapor barrier has no effect on the requirements of this section.

One other note, North Dakota has the same rules for EMT.

**47.** Are general-use Rigid Metal Conduit compression-type fittings allowed in a Class 1 Division 2 location?

**Answer:** This is another code change in the 2017 NEC. The answer is Yes. 501.10(B). Listed threadless fittings are allowed in class 1 division 2 locations.

**501.10 Wiring Methods.** Wiring methods shall comply with 501.10(A) or (B).

**(B) Class I, Division 2.**

**(1) General.** In Class I, Division 2 locations, all wiring methods permitted in 501.10(A) and the following wiring methods shall be permitted:

(1) Rigid metal conduit (RMC) and intermediate metal conduit (IMC) with listed threadless fittings.

**48.** Can I use a 4-foot long piece of 1" liquidtight flexible metal conduit, with listed fittings, as an equipment grounding conductor on a 40-amp circuit where flexibility is not required?

**Answer:** Yes, you may. 250.118(6). As long as you follow the limitations, and no more than 6 feet of liquid tight flexible metal conduit in the entire circuit.

**250.118 Types of Equipment Grounding Conductors.**

(6) Listed liquidtight flexible metal conduit meeting all the following conditions:

a. The conduit is terminated in listed fittings.

b. For metric designators 12 through 16 (trade sizes 3/8 through 1/2), the circuit conductors contained in the conduit are protected by overcurrent devices rated at 20 amperes or less.

c. For metric designators 21 through 35 (trade sizes 3/4 through 1 1/4), the circuit conductors contained in the conduit are protected by overcurrent devices rated not more than 60 amperes and there is no flexible metal conduit, flexible metallic tubing, or liquidtight flexible metal conduit in trade sizes metric designators 12 through 16 (trade sizes 3/8 through 1/2) in the ground-fault current path.

d. The combined length of flexible metal conduit and flexible metallic tubing and liquidtight flexible metal conduit in the same ground-fault current path does not exceed 1.8 m (6 ft).

**49.** What is the minimum distance a receptacle must be located away from a sink? What about a bathtub with a shower?

**Answer:** The NEC does not give a minimum distance for receptacles by sinks, you can have a receptacle right above a sink, probably not the best location for a receptacle. Remember, in dwellings all 120 volt, 15 or 20 amp receptacles that are within 6 feet of any sink requires to be GFCI protected. NEC 210.8(A).

The NEC does address receptacles by bathtubs and shower stalls.

**406.9(C) Bathtub and Shower Space.** Receptacles shall not be installed within or directly over a bathtub *or* shower stall.

**50.** I have been told that I must keep telephone (communication) cables at least two inches away from power cables in a dwelling. Where is this requirement in the NEC?

**Answer:** 2 inches. NEC 800.133(A)(2)

**800.133 Installation of Communications Wires, Cables, and Equipment.**

**(A) Separation from Other Conductors.**

**(2) Other Applications.** Communications wires and cables shall be separated at least 50 mm (2 in.) from conductors of any electric light, power, Class 1, non-power-limited fire alarm, or medium-power network-powered broadband communications circuits.

**51.** I want to wire a 75 KVA, 3-phase, 480-volt primary, 208-volt secondary transformer, with both sets of the wiring in the same conduit from a large j-box. There is OC protection on the primary conductors. Is this a NEC violation?

**Answer:** No. The NEC doesn't prohibit this type of installation. 230.7 does say that you cannot have other conductors in the same raceway as service conductors. Transformer secondary conductors are not service conductors, since there is OC protection on the primary, if sized correctly will also protect the secondary conductors. NEC 310.15(B)(3)(a) does require a reduction of ampacity when there are more than 3 current carrying conductors in a raceway, so with this reduction this type of installation may not be feasible.

**52.** Someone told me that receptacles for built in dishwashers cannot be behind the dishwasher anymore. Is that true?

**Answer:** Yes, that is true, a code change in the 2017 NEC, Article 422, Appliances, 422.16. The receptacle for the built in dishwasher has to be in the cabinet next to the dishwasher.

**(2) Built-in Dishwashers and Trash Compactors.** Built-in dishwashers and trash compactors shall be permitted to be cord-and-plug-connected with a flexible cord identified as suitable for the purpose in the installation instructions of the appliance manufacturer where all of the following conditions are met:

(2) For a trash compactor, the length of the cord shall be 0.9 m to 1.2 m (3 ft to 4 ft) measured from the face of the attachment plug to the plane of the rear of the appliance.

(3) For a built-in dishwasher, the length of the cord shall be 0.9 m to 2.0 m (3 ft to 6.5 ft) measured from the face of the attachment plug to the plane of the rear of the appliance.

(4) Receptacles shall be located to protect against physical damage to the flexible cord.

(5) The receptacle for a trash compactor shall be located in the space occupied by the appliance or adjacent thereto.

(6) The receptacle for a built-in dishwasher shall be located in the space adjacent to the space occupied by the dishwasher.

(7) The receptacle shall be accessible.

**53.** My water pipe ground clamp accepts up to a #2 wire size. Can I attach a lug to it to accept a larger conductor?

**Answer:** Probably not, the clamp should be used to secure only the range of wire sizes (both the smallest and largest) identified on the connector or box the clamp is shipped in. Installation of the water pipe ground clamp has to be installed as per listed label and instructions, NEC 110.3(B) and installed as per NEC requirements in 250.8. If the manufacture of this water pipe ground clamp includes an accessory kit to attach larger conductors, then it will be ok.

**54.** Is it a code violation to have general purpose receptacles on the same lighting circuit that has required battery- backup emergency lights?

**Answer:** Battery backup 'unit equipment' is found in 700.12 'F' that requires it to be on the same branch circuit as serving the normal lighting in the area, ahead of any switches.

So if 'lighting in the area' also have receptacles in this case there seems to be no violation.

This could be a violation if the emergency system is required and connected to an emergency generator. 700.15.

**55.** 550.25 states that AFCI protection is required and shall comply with 210.12. Why do these panels leave the factory without the AFCI protection installed?

**Answer:** Article 550 is for Mobile Homes. 550.25 does require AFCI protection, but it is not enforceable by the AHJ. 24 CFR Part 3280, 2010 Revision, Manufactured Home Construction and Safety Standards The U.S. Department of Housing and Urban Development mandates federal standards for design, construction, and installation of manufactured homes. These standards preempt state and local laws that are not identical to the federal standards. The only jurisdiction the AHJ has is the feeder connection to the mobile home panel.

**56.** Does the NEC allow a 4” square box for a t-grid lighting fixture branch-circuit to be attached to the t-grid if a support bracket made for this purpose is used?

**Answer:** NEC 314.23 (D) (2) and NEC 300.11 (A) (1) & (2)

Yes, the 4”sq box can be attached but not supported by the t-grid. 314.23 (D) tells us that junction boxes not exceeding 100 cubic inches may be installed above a suspended ceiling provided they are securely fastened in accordance with either (D) (1) or (D) (2). (D) (2)

Support Wires, states the installation must comply with 300.11 (A). The enclosure shall be secured, using methods identified for the purpose, to ceiling support wires, including any additional support wires installed for that purpose. Support wires used for enclosure support shall be fastened at each end so as to be taut within the ceiling cavity.

300.11 (A) Raceways, cable assemblies, boxes, and fittings shall be securely fastened in place. Support wires and associated fittings that provide secure support and are installed in addition to the ceiling grid support wires shall be permitted as the sole support. Where independent support wires are used, they shall be secured at both ends. Cables and raceways shall not be supported by ceiling grids, but shall be permitted to be attached to the assembly. Where additional support wires are used they must be distinguishable by color, tagging, or other effective means.

There is an exception to 300.11(A)(2)

*Exception: The ceiling support system shall be permitted to support branch-circuit wiring and associated equipment where installed in accordance with the ceiling system manufacturer’s instructions.*

**57.** I have a detached 2- car garage. I am supplying 100 amp feeder from the house feeding the garage panel. I have 6-20 amp breakers in the panel feeding lights and receptacles. The inspector wants me to install a main breaker. Does the 6 switch rule in NEC Art 230.71 apply?

**Answer:** 225.30, 225.31, 225.32, 225.33 and 408.36

You do not need a main breaker in the garage panel when you have no more than 6-20 Amp breakers in the panel. But not because of 230.71, rather because of 225.33.

Your reference of Section 230 is incorrect as it is for services. The 100 amp circuit to the garage panel is a Feeder not a Service. Article 225 must be consulted for this application.

- Section 225.30 tells us we can only have one feeder serving this location.

- Section 225.31 tells us we need a single disconnect and

- 225.32 tells us where it needs to be.

- Section 225.33 tells us the maximum number of disconnects at this location.

- **225.33 Maximum Number of Disconnects.**

- **(A) General.** The disconnecting means for each supply permitted by 225.30 shall consist of not more than six switches or six circuit breakers mounted in a single enclosure, in a group of separate enclosures, or in or on a switchboard. There shall be no more than six disconnects per supply grouped in any one location.

408.36 requires that the panel board be protected by an over current device any place on the supply side of the panel board. In this installation, the breaker that is protecting the garage panel is located in the house. This installation is correct.

**58.** If I have a separate underground service for a fire pump entering the fire pump controller at the nearest point of entry, and the controller has a disconnecting means built into it (they are all service rated by code), do I need an additional disconnecting means ahead of the controller?

**Answer:** No... 695.4 states to use A or B. 'A' States to *direct connect* to a Listed fire pump controller or Listed combination fire pump controller and power transfer switch. 'B' *allows*, but not requires, another disconnecting means as long as it follows the rest of the requirements found in B1,2,3.

**59.** I have installed a large generator with a 400 amp rated over current protection breaker. I want to feed from this generator to 2 buildings with 200 amp transfer switches at each building. Am I allowed to install 3/0 copper conductors on the load side of the generator 400 amp breaker to each transfer switch or do I have to size all conductors for the 400 amp breaker?

**Answer:** 2014 NEC, you would have size the conductors to the size of the 400 amp breaker. In the 2017 NEC 445.13(B) you are allowed to tap off the load side of the breaker as long as you follow the tap requirements in 240.21(B)(5)

**(B) Overcurrent Protection Provided.** Where the generator set is equipped with a listed overcurrent protective device or a combination of a current transformer and overcurrent relay, conductors shall be permitted to be tapped from the load side of the protected terminals in accordance with 240.21(B). Tapped conductors shall not be permitted for portable generators rated 15 kW or less where field wiring connection terminals are not accessible.

Outside taps, the length of conductors is unlimited, the conductors must terminate in a single breaker properly sized to the tap conductors before the transfer switch.